
FCE Rehabilitation



Final Report

CONTRACT :

PCE-I-809-00-000030, TO #809

SUBMITTED TO :

USAID / MADAGASCAR

SUBMITTED BY :

CHEMONICS INTERNATIONAL

HARZA INTERNATIONAL

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List of Acronyms

FCE	Fianarantsoa Côte-Est Railway
FCER	FCE Rehabilitation Project
USAID	United States Agency International Development
AfDB	African Development Bank
LDI	Landscape Development Interventions
ADB	African Development Bank
UNDP	United Nations Development Program
CIM	Compagnie Internationale de Maintenance
SNCFI	Société des Chemins de Fer (Française) Internationale
NGO	Non Governmental Organization
AUP	Association des Usagers des Pistes
ADI-FCE	Association des Détenteurs d'Intérêt de la FCE
OPCI	Inter-communal Association
CAP	Commercial Agricultural Production Project
RECAP	USAID's cyclone recovery for roads

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I. Background to the FCER Project

In February and March 2000, Cyclones Eline and Gloria smashed the east coast of Madagascar in rapid succession, inauspiciously announcing the start of the new millennium to one of the poorest and most vulnerable populations on the face of the planet. In even the best of times, the inhabitants of this spectacular and lushly productive but remote region were anxiously dependent on the arrival of a tired old railway engine that barely managed to pull its load of rickety wagons to the top of the escarpment and the markets that awaited its precious loads of bananas and other fruits. Now after one of the most violent cyclone seasons in memory, whole mountains had slid from their moorings onto the railroad track; rivers had risen to record levels, washing out fragile embankments and leaving track hanging by a few rusty spikes; for kilometer after kilometer there were hardly traces of a rail to be seen under the debris of mud and brush.



The first mission to inspect the damage to the FCE train line, March 2000

With crops destroyed, roads washed out, and the rail lifeline broken, some 100,000 people faced a grim future in the short term. But they were also confronted by the ominous likelihood that they would sink to new levels of food and health insecurity in the medium and longer term as they were forced to abandon relatively productive and sustainable livelihood systems in favor of erosion inducing and little productive annual crops. All this because there was no transport to move bananas, litchis, coffee, and other commercial crops out of the region.

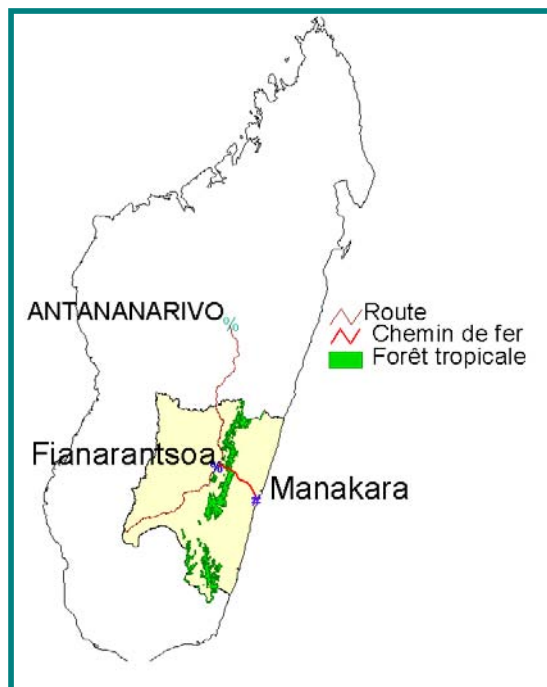
Disaster specialists came to inspect the damage and then quickly moved on, unimpressed since there was no evidence of emaciated children huddled along the line or people standing woefully in front of flattened houses. Wise from centuries of experience dealing with the force of recurrent cyclones, people on Madagascar's eastern coast were not having their babies in trees because they had improvidentially built houses in the flood plains as the news reports were showing in Mozambique. The disaster specialists had insufficient imagination and foresight (or maybe just too many other crushing catastrophes) to anticipate the situation six months later and the consequences to a population that had been robbed of the transport that assured their food and health security: higher prices and decimated incomes leading to increased malnutrition, reduced ability to pay for medicines and fewer doctors in a region now without transport services.

Putting money into the FCE railway was a gamble that few were willing to take in the weeks and months after the cyclones; some (like the disaster specialists) couldn't see the need; others thought (not without reason) it to be a rather hopeless cause. There were, however, a few who did believe that it was both necessary and possible to reopen the line, and a few others who were willing first to listen to the arguments and then to take the bureaucratic

risks needed to make it happen. This final report on the achievements of the FCER project and the train line it saved is a tribute especially to those bold and visionary people at USAID who were willing to take the gamble and to support this venture through its myriad ups and downs. As we write this report, three years and a few months after the passage of the cyclones, the train is once again the life-line of its region, running on its still tortuous but now reliable trajectory heavily laden with the fruits of many labors.

I.1. Context

It is impossible to understand the mission and the accomplishments of the FCER project without reference to the Landscape Development Intervention (LDI), the USAID funded conservation and development program that launched the cyclone recovery interventions in Fianarantsoa province.



The FCE railway, which crosses the Fianarantsoa forest corridor, plays a vital role in conserving this threatened tropical forest.

LDI, following on the CAP project also financed by USAID and active in Fianarantsoa, began operations in 1998. While active in other provinces of Madagascar as well, its activities in the Fianarantsoa province have been oriented toward the conservation of the highly threatened forest corridor that runs north-south between Ranomafana and Andringitra National Parks. This forest corridor plays a critical role both in maintaining Madagascar's biodiversity and ensuring the health of watersheds that play a critical role in assuring agricultural production and hence the food security of the region.

When Cyclones Eline and Gloria struck Madagascar in 2000 with particularly devastating impacts on the Fianarantsoa region, LDI was among the first responders. The FCE railway, which bisects LDI's zones of intervention as it crosses the forest corridor on its eastward trajectory from the highlands to the coast, was particularly badly hit by the cyclones. 280 landslides dumped more than 150,000 cubic meters of earth on the rails, and eight major washouts left gaping holes in the track. The railway, already weakened by decades of non-maintenance and a lack of government investment, was threatened with almost certain closure unless

significant emergency interventions were funded. At a time when the situation seemed very close to hopeless, LDI (with initial funding help from private contributions including the Methodist Church and concerned individuals) took its first tentative steps to helping the FCE railway company clear the landslides in hopes of reopening the line. At the same time, the PAGE-EPIQ project (also financed by USAID but focused on conservation policy issues) moved ahead with plans to carry out an already scheduled cost-benefit study to more systematically document the impact of the FCE railroad on the environment and the economy of the Fianarantsoa Region.

The PAGE studies, carried out in April and May 2000 in the immediate aftermath of the cyclones, confirmed that the environmental and economic impacts would be disastrous for the province of Fianarantsoa should the FCE fail to resume service, or reopen and then

continue on its moribund course to eventual closing due to overall deterioration and lack of maintenance.

The arguments, in a nutshell, were that the train (which passes through a remote but agriculturally productive region with few other transport options) allows farmers to practice a commercial agriculture system that is based largely on sustainably produced tree crops (bananas, coffee, citrus, litchis, etc.). Should this transport service not exist, the population of some 100,000 people that depend on the train line for transport would cut their trees and instead turn to the production of annual crops such as rice and manioc in order to ensure their household food security. The production of such annual crops on steep and erosion prone hillsides leads to rapid soil infertility and the need to expand onto new cropland as infertile fields are taken out of production. This would inevitably lead to forest clearing (the PAGE study estimated that more than 150,000 hectares would be cut in 20 years should the train cease to function) and significantly accelerate the loss of the forest corridor.

The FCE Railway is a key element in Fianarantsoa's Environment-Transport-Development Nexus

From the outset, USAID's investments in the railway have been justified by the FCE's role in conserving the Ranomafana/Andringitra forest corridor which, in turn, plays a critical role in

- (1) maintaining the hydrological integrity of the province of Fianarantsoa and, therefore, the food security of large number of people and
- (2) protecting the biodiversity of this unique and threatened tropical environment.

Based on its own experience with farmers along the line and this clear quantitative evidence of the FCE railway's impact on the forest corridor, LDI mobilized in an effort to save the railroad. Initially, and with USAID's concurrence, LDI's own project funds were used to begin emergency operations to reopen the line. Later USAID contributed additional mission funds to the emergency interventions. At the same time, supplemental funds were sought as needed to ensure more substantial emergency and rehabilitation activities. The USAID mission's persistent and determined efforts resulted in the allocation of a part of the Southern Africa supplemental cyclone funds (primarily destined for Mozambique under the RAISE IQC) to be directed to emergency interventions on the FCE. \$4.7 million was allocated to the FCE Rehabilitation project via a Task Order awarded to Chemonics International. Implementation of the FCER Project began in February 2001.

The presence of LDI, already highly operational in Fianarantsoa and knowledgeable about the challenges confronting the FCE, was an enormous advantage in accelerating the implementation of FCER. Several of the key staff members who were recruited by the FCER project (namely the Regional and Technical Directors) had already been active in emergency interventions financed by LDI and had a clear idea of the most urgent priority interventions. (These interventions became the core of the Fast Track Activities that were implemented during the first months of the project during the period that more detailed technical studies were being carried out.) In addition to this technical information, project staff already had a good relationship of trust with both the staff of the FCE railway and the populations living along the line. Each of these was invaluable in allowing FCER to move ahead quickly and efficiently once the cyclone funds were released. And finally, FCER was able to learn from the experience of LDI, which having started emergency interventions that were carried out directly by the railroad workers, had more recently begun to experiment with the use of private contractors (reinforced where necessary with technical assistance from railway employees and former employees). Since the latter proved to be both more cost-effective and more easily subject to rigorous quality control, the approach was adopted by FCER from the outset, without major opposition from the rail system.

The Context (1)

Cyclones Elline (February 2000) and Gloria (March 2000)

While neither of these cyclones was, by itself, of particular virulence or intensity, the combination of two major storms within two weeks was catastrophic. The province had not yet dried out from the first storm when the second hit, and the cumulative damage to crops (which were nearing harvest) and especially to infrastructures was impressive. The FCE train line suffered 280 landslides and 8 major washouts. For many kilometers there were few traces of the tracks, which had been buried under tons of debris. The damage was in large part caused by a failure to maintain drainage systems along the line; slopes weakened at the base quickly eroded under the continuing deluge. Another contributing factor was the cultivation of annual crops (especially manioc that is uprooted when harvested just before the rainy season) along the very steep slopes abutting the line.



The Context (2 : Interventions before FCER)

Emergency interventions to re-open the line and initial stabilization activities carried out under the LDI project : March to December 2000

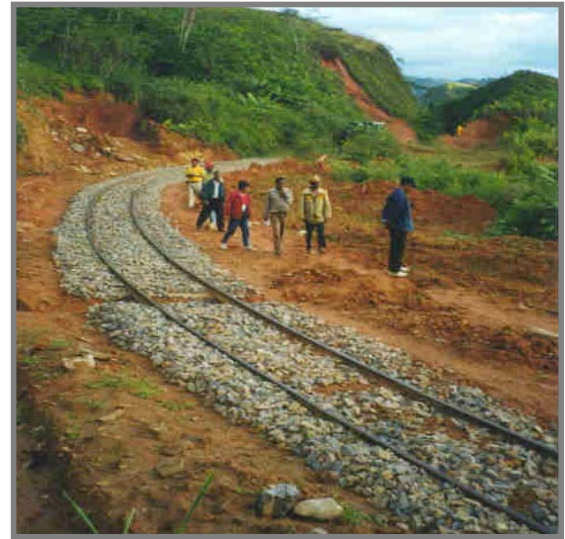
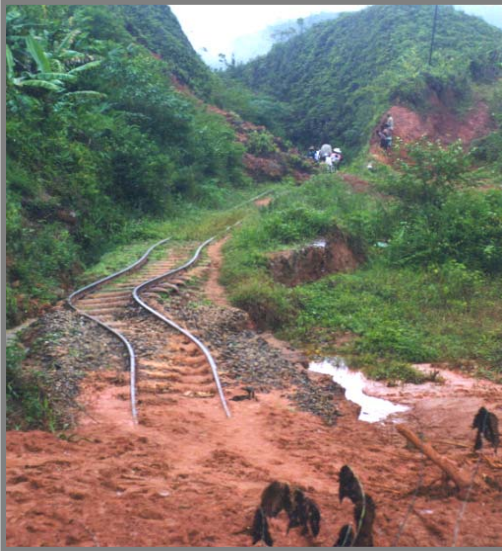
The LDI program provided the first response after the cyclones, working with the FCE to clear landslides from the track, relaying track as required where platform had been damaged, and rebuilding 8 areas where platform subsidence had left the track hanging

Goal: Allow the train to pass so as to ensure the transport of people and freight, though sometimes at speeds as slow as 5 km/h

Achievements: The line opened June 1, 2000

Technical observations: Most of this work was done by reinforcing the efforts of the FCE itself (providing equipment, materials and hiring some additional local labor) ; the visit of two Thai vetiver specialists in 2000 helped LDI to define the most effective use of vetiver and begin to put appropriate slope stabilization and community measures in place.

These photos show interventions at one "Point Noir," stabilized under LDI and then reinforced (including implementing a program for vetiver maintenance) under FCER.



I.2. Goals of the FCER Project

The Task Order called for technical services to design, manage, and supervise the rehabilitation of the FCE Railway. Specifically, this was to carry out engineering design services and manage the construction contracts carried out during the rehabilitation works.

The FCER project further established and defined its goals in the Revised Implementation Plan submitted to USAID in July 2001:

1. Attain the specific technical objectives (in terms of infrastructure and materials rehabilitation) in the time period specified;
2. Assure reasonable train service over the life of the project; and
3. Invest USAID funds (and encourage other donors to invest the necessary funds) to bring the FCE to an operational level where it can attract private investors (concessionaires) interested in taking over the operation of the rail line.

While initial technical specifications (point 1) were laid out in the Task Order for this project (and are reprinted in Annex 1 of this report), it was clear from the outset that these initial objectives would have to be revised. They had been defined by a non-technical team at a time when it was almost impossible to assess the real state of the line (given that it was still largely buried and inaccessible in the months immediately following the cyclones when the first USAID consultants made their visits). Hence, one of the priorities of the project was to carry out a Master Plan Study that would determine the overall needs for investment in the train line, but also specify the most critical and urgent interventions. These latter formed the basis for the revised specific technical objectives of the project:

- ❑ 25 km of drainage ditches cleaned and maintained (to protect the line against future cyclone damage)
- ❑ 21 drains or culverts rehabilitated (to reinforce the line against future cyclone damage)
- ❑ 10 new drains or culverts completed (to reinforce the line against future cyclone damage)
- ❑ 125,000 linear meters of vetiver planted to stabilize embankments and reinforce drainage structures (to reinforce the line against future cyclone damage)
- ❑ 300 farmers trained in hill-slope stabilization techniques (to reinforce the line against further cyclone damage)
- ❑ 40 km of track stabilized (in fact this was done by introducing measures to increase safety over the whole line; the equivalent of more intensive measures on a 40km stretch)
- ❑ Return to Service of 1.5 km of track between rail station and port of Manakara (to allow the import of rails and other materials through the port)

Revisions to the Expected Results Outlined in the Task Order.

FCER proposed that the Expected Results established by the Task Order be revised because:

1. Some of the initial goals did not reflect the most urgent and priority interventions to put the line back in service (often because there was inadequate information available at the time the Task Order was issued and a full scale technical study had not been carried out);
2. The Task Order was in some cases vague and needed to be clarified (e.g. 25,000 meters of structures repaired);
3. Other donors agreed to carry out some activities initially anticipated in the Task Order (for example, bridge and tunnel repairs were taken over the AfDB) and so FCER was able to reallocate these funds to other needed investments.

- 3 locomotives functioning at 80% (so as to provide reliable transport service for the local population and as needed to carry out track and infrastructure rehabilitation).

The general approach of the FCER project was as follows:

Phase I of the project (roughly February 2001 to September 2001) involved carrying out a systematic study of the rehabilitation needs of the line. At the request of the Malagasy government (and reaffirmed in USAID's agreement with Chemonics), the Master Plan Study was not limited to rehabilitation of damage strictly caused by Cyclones Eline and Gloria, but rather looked more comprehensively at what was needed to bring the FCE back to sustainable operation. This would, inevitably require more resources than what were available under the Task Order. Based on the needs identified in the Master Plan, the FCER project would then decide which were the priority needs and finance those up to the available funds, while simultaneously seeking other funding sources for the remaining work.

During Phase I, while the studies were being carried out, the project invested a limited sum (\$300,000) in Fast Track Activities that were universally agreed to be the most urgent interventions. This meant that emergency interventions did not have to be delayed while waiting for the results of the Master Plan Study.

Once the results of the Master Plan were available, the project revised its specific technical objectives so as to reflect the priority needs as determined by the team of international and Malagasy rail and civil engineering experts who carried out the study. These new objectives are the ones outlined on page 6 above.

The project then carried out two phases of what we called « Main Track » (as opposed to Fast Track) activities. The first phase was implemented from September to December 2001 (until the rainy season precluded further work on the line). Progress was assessed during the dead (for track work purposes) months of the rainy season and contracts were put in place for the next phase of Main Track activities (April to December 2002). Some activities (such as rehabilitation of the locomotives), which were not restricted by weather conditions, spanned both Main Track I and Main Track II periods.

In this way, the project has successfully used a system of « adaptive planning » to ensure the best use of funds throughout the life of the project. This has been the most effective strategy because we started the project with imperfect information about both the rehabilitation needs of the FCE and the resources that would be available to respond to these needs. As time progressed, we had access to additional information and were able to reprogram our funds to ensure that we were doing the most critical and urgent activities based on the information available at each point in time.

Examples of evolving information that was incorporated into the adaptive planning model:

1. Technical information. The Master Plan Study carried out in 2001 helped immeasurably in strategic planning of project resources, but was imperfect given the difficulties in assessing the situation when the line was still in very poor shape. Most of the line was still covered in dirt (except for the two rails) when the study was

Adaptive Planning was essential to ensuring the strategic and cost-effective use of funds.

Adaptive Planning has been crucial to the success of this project given the limited information available at the outset and the need to act quickly. We started with those interventions that were clearly the most urgent and critical and planned the follow on activities as more information (and in some cases resources from other donors) became available. The overall objectives never wavered, but the means to reaching those objectives most effectively were constantly reevaluated as the project progressed.

At each stage of the planning we (the FCE and FCER team) asked: "What are the next most urgent and critical needs to ensure safe and reliable transport on the FCE?" In some cases, the answer required us to revise our intended expenditures, such as when removal of dirt from buried track revealed an alarming lack of fixtures attaching the rails to the ties. The next round of investments included the purchase of 130,000 track attachments (nuts, bolts, and fishplates). Conversely, track clearing revealed some deeply buried cement drainage canals that even the FCE did not know existed. These allowed us to reduce the length of new drainage canals to be built under the Master Plan and instead focus more resources on cleaning and maintaining the existing infrastructures.

carried out and thus we had only an impressionistic picture of (for example) the state of ties and fixations. Over time, as we carried out track cleaning and ballast operations, we gained a much better sense of what the true problems were and were able to reorient funds to the most priority needs.

2. Information about complementary funding. Our strategy, in general, was to optimize the whole rehabilitation effort, rather than merely focusing on the effective use of USAID funds. We were constantly trying to leverage other donor funds, and as we got additional commitments were able to reprogram our own funds in complementary ways. If we found out that, for example, that PNUD was willing to fund some track cleaning, we might reprogram USAID funds to do less cleaning and more drainage construction. In other instances, funds (such as from the African Development Bank) that we had thought would be available for emergency interventions (e.g. slope stabilization) were much delayed

and we were obligated to intervene using USAID funds to ensure that the line remained safe and operable. In such cases, we transferred less time sensitive interventions to the slower funding mechanisms (the AfDB was assigned bridges and tunnels whose rehabilitation was judged to be less time sensitive).

3. Political realities. The project's adaptive planning approach was tested to its limits with the political crises of 2002 when we were confronted with severe logistical constraints in terms of our ability to move people and equipment (due to blockades and fuel restrictions). Fortunately, the team was already well experienced in adaptive planning and was able to quickly revise its strategy and put resources into activities that were based on local resources (e.g. drainage ditch construction), while postponing those that required, for example, imported rails and parts. We suspect that a more « linear » project might have had difficulties (and possibly ended up with unspent funds because some planned activities could not be carried out), but we were able to quickly and strategically re-deploy resources in the face of such a major challenge.

I.3 Project Time line

1.3.a. Overall Phasing of the FCER Project interventions

February 2001 to August 2001	Fast Track Implementation and Master Plan Development
September to December 20001	Main Track I Implementation
January 2002 to March 2002	Assessment and Planning (locomotive rehabilitation started during this period)
April 2002 to December 2002	Main Track 2 Implementation
December 5, 2002 to April 2003	Cost extension to finalize interventions delayed because of political crisis (which delayed, for example, the delivery of locomotive parts)
May 1 2003	Staff transfers to LDI to continue rehabilitation activities with leveraged funds from other donors.

1.3.b Specific project benchmarks

2001

January 4	Chemonics submits Task Order Proposal to USAID
January 31	Task Order Contract Becomes Effective
February 10-14	First staff contracts signed in-country
March 1	Project team Building in Antananarivo
March 15	Fast Track Plan submitted to USAID
April 28	Grand opening of Project in Fianarantsoa with showing of film « Train Dans la Falaise »
End June	Initial Fast Track Activities completed (20 km of track cleaned; 4 Points Noirs reinforced, 11 drainage infrastructures built; other contracts in progress)
June 20	Master Plan Study Results Available for Discussion
July 31	Revised Implementation Plan submitted to USAID
August 20	Dinika Engineering submits Project APD
August 20	DAO draft for AfDB funding submitted to Ministry of Transport/PST and USAID
October	Sheltam Locomotives and SNCFI make prospecting visits to Madagascar and the FCE to initiate privatization discussions
October 15	Donor Roundtable Conference in Antananarivo elicits ~\$10 million of complementary funds
October 19-21	First annual visit of Donors and Government Officials to the Line (includes Minister of Transport and the DG of the Ministry of Environment, Governor of Fianarantsoa)
December 3	CIM team arrives to begin locomotive rehabilitation/maintenance contract
December 29	First Swiss shipments of rail and track materials arrive in Fianarantsoa
Sept. to Dec.	Complete remaining Fast Track and Main Track I Activities including construction of passing track at 5 stations, rehabilitation of wagons needed to transport ballast, completion of another 10 drainage structures.

2002

January – July	Period of significant political unrest in Madagascar
March – Dec.	Main Track II Activities carried out (track security, drainage, slope stabilization)
April 24	2 nd and 3 rd Swiss Shipments arrive Fianarantsoa
July 12	First rehabilitated locomotive (BB 242) makes its maiden run
September 28	Second Rehabilitated locomotive (BB245) makes its maiden run
September	Two draisines fully rehabilitated and functional
October 30	Second Annual visit of Donors and Government representatives to the FCE (includes US and British Ambassadors, Minister of Transport, PDS of Fianarantsoa, Sec. General of Transport, World Bank representatives)
December 12	Third Rehabilitated Locomotive (BB 243) takes its maiden run
December 9	Second major lot of track materials arrives in Fianarantsoa

Impact of the 2002 Political Crisis

The 8-month political crisis following the elections of December 2001 posed numerous challenges but failed to deter the FCER team in its determination to successfully complete this project that was, after all, born of misfortune.

Among the challenges caused by the crisis were:

- Violence in Fianarantsoa that hindered normal office operations for 2-3 months
- Great difficulties in obtaining fuel for several months
- Banks and foreign exchange markets closed
- The port of Tamatave closed and bridges destroyed between the coast and Fianarantsoa, making it almost impossible to import locomotive parts and rail materials
- Mandatory evacuation of the Regional Director for 4 months

We are grateful to USAID for granting us a 5-month extension that enabled us to meet all our objectives, but over a moderately extended time frame. This extension helped compensate for delays resulting from the crisis.

2003

February 10	4 th Swiss shipment arrives Fianarantsoa
April 4-5	Third major visit to the line by new Ministerial and provincial staff

II. Project Accomplishments

The overall success of this project can perhaps best be summarized by the results below that reflect key service indicators on the FCE:

	Average passenger train trip (FIA-Manakara) in hours	Number of cancelled trains per 3 month period (Jan-March of year indicated)	Number of scheduled passenger trains per week (freight trains vary according to demand)
1999 (pre-cyclone)	11 hours	8	6
March 2000 (post cyclone)	Train could not pass due to 280 landslides	NA	0
March 2001 (start FCER)	10 hours	19	6
March 2003 (now)	8 ½ hours	5	10

It should be noted that there is currently no technical reason that the trains cannot regularly make the trip between Fianarantsoa and Manakara in 6-7 hours. The outstanding issues are management (as opposed to technical) issues involving, for example, inefficient systems for loading and unloading and the operation of combined passenger/freight trains. These issues will presumably be resolved when a private operator takes over the line. Indeed, on Sunday, June 28, 2003, a normal passenger train left Fianarantsoa at 7 am and arrived in Manakara at 1:15 pm, accomplishing the journey in just over 6 hours.

II.1. Quantitative Project Indicators

As summarized in the following table, the FCER project met or exceeded all of its quantitative indicators

Targeted Results (per the Revised Task Order)	Progress in Achieving Results
25 km of drainage ditches cleaned and maintained	53.9 km of drainage ditches cleaned
21 drains or culverts rehabilitated	21 drains and culverts rehabilitated
10 new drains or culverts completed	10 new drains or culverts completed
125,000 linear meters of vetiver planted to stabilize embankments and reinforce drainage structures	148,486 linear meters of vetiver slips planted
300 farmers trained in hill-slope stabilization techniques	353 farmers trained in hill-slope stabilization techniques (in addition to 95 under LDI's cyclone recovery activities which financed the 1 st season)
40 km of track stabilized	56 km of track stabilized (ballast cleaned, joints soldered, rails replaced, and/or ties replaced)
Return to Service of 1.5 km of track between rail station and port of Manakara	1.25 km of track spur reopened (making the spur fully functional; the original indicator was incorrect given the distance between the train station and the port)
3 locomotives functioning at 80%	First locomotive (BB242) completed July 8, 2002; Second Locomotive (BB245) delivered September 28, 2002 Third locomotive (BB 243) fully functional April 8, 2003 The combined rate of availability since rehabilitation of the FCE locomotive park has been 93.5% (see table in Annex 4)

II. 2 Project Technical Results

In the following pages we report both quantitatively and with visual illustrations on the main interventions carried out over the life of the FCER project, including (i) slope stabilization activities, (ii) improvements to drainage systems, (iii) interventions to secure the track platform, (iv) investments in rolling stock, and (v) community activities to protect the FCE railroad from erosion by planting vetiver on steep slopes adjacent to the line.

Slope Stabilization (~ \$130,000)

Finished slope compaction begun under LDI, added gabion and/or vetiver as needed to protect against future erosion

Task: Limited resources and time meant that the emergency interventions carried out by LDI were not yet fully stabilized; additional interventions were needed at 10 *points noirs* to protect the line against additional erosion.

Achieved: 10 *points noirs* stabilized to prevent further degradation, as well as the tunnel at PK 121. In spite of heavy rains in 2002/3 (due to the passage of a cyclone and a tropical depression) there were no landslips of a magnitude to close traffic on the line. With good maintenance, the FCE should no longer experience major traffic disrupting landslides that require expensive interventions.

Points Treated: PK 31+000, 58+100, 75+750, 89+300, 90+100, 90+200, 95+100, 102+500, 102+900, 118+350, 121+900

Technical Observations: Vetiver was systematically used for all slope stabilization activities; in some cases vetiver alone was sufficient to ensure stability; in others vetiver combined with gabion provided the most cost-effective solution.

Perspectives: There are some places on the line where adding cement lined drainage canals to the base of erosion prone slopes will provide additional protection and facilitate maintenance. 17 such vulnerable slopes will be reinforced with improved drainage canals to be funded by the AfDB. Since only exterior tunnel work (stabilization of the slope on top of the tunnel) has been carried out by FCER, AfDB will also continue work on the interior of Tunnel PK 121.



Cleaning of existing drainage canals

Task: Clean existing drainage ditches of mud and debris in order to assure effective drainage of water from the line. As can be seen in the pictures, this involved a measure of engineering archeology since it was not always clear where cement line ditches already existed, and where the task was limited to cleaning earthen ditches. In some cases we had to revise contracts when we “discovered” the existence of deeply buried cement drains.

Achieved: 54 kilometers cleaned. Formerly the FCE depended on its own workers to clean these ditches; the project has now put into place a cost effective system of contracts with private enterprises and village associations along the line to maintain the ditches and track bed (see platform).

PK where intervened (NB: PK refers to the *Point Kilométrique*. the line starts at PK 0 in Fianarantsoa and goes to PK 163 in Manakara) : PK 38+700 to PK 77+00, 79+800 to 89, 92+600 to 95+300, 103+800 to 106+700.

Perspectives: The key is now, of course, to insure adequate cleaning of the excavated ditches; this requires systematic intervention at least twice a year, before and after the cyclone season, with minor interventions as needed to clear debris throughout the year.



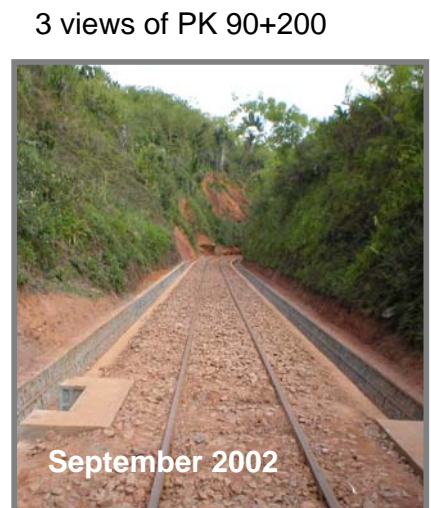
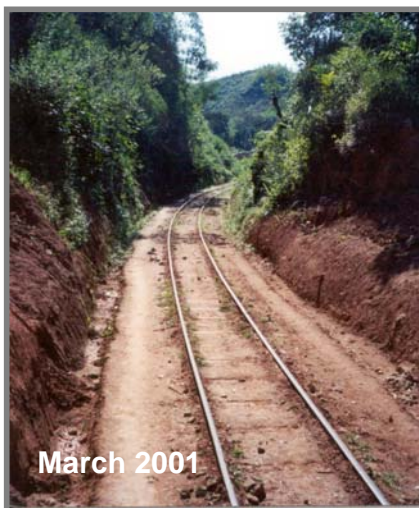
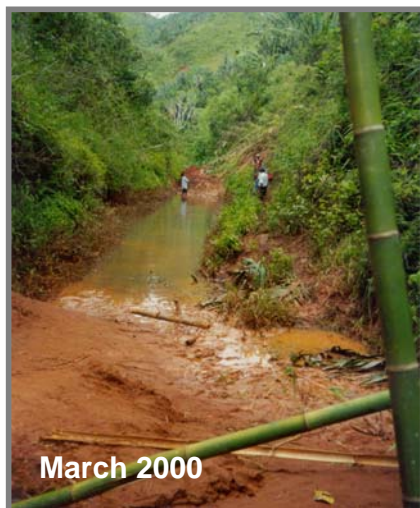
Improvement of drainage canals by the addition of concrete linings

Task: There are areas of the track where the volume and force of water to be drained recommend the use of cement lined, rather than dirt, drainage canals. The Master Plan prioritized areas where improvements were needed and identified 32 km that should be urgently improved (because the risk of landslides and erosion was the highest) and 20 km that were of a secondary priority, but still important.

Achieved: The FCER project has built 2.4 km of cement lined ditches, significantly reducing the risk of landslide in places which are both particularly vulnerable to erosion and where clearing of earth is most difficult because the track passes through a “canyon.”

PK where intervened: PK 31 (510 m), PK 80+400 (250m), PK 90 (630 m), PK 95 (480m), PK 105+100 (370m), PK 105+800 (130m)

Perspectives: ~ The 30 km of highest priority concrete drainage ditches have been proposed to FID and IPTE for funding in 2003)



3 views of PK 90+200

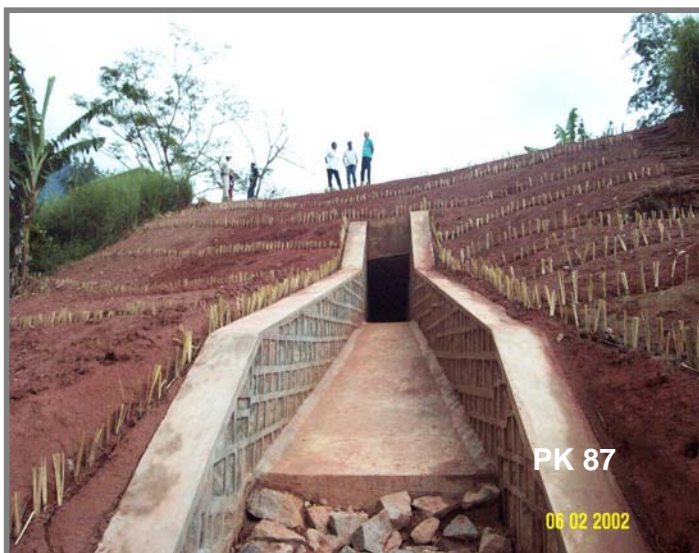
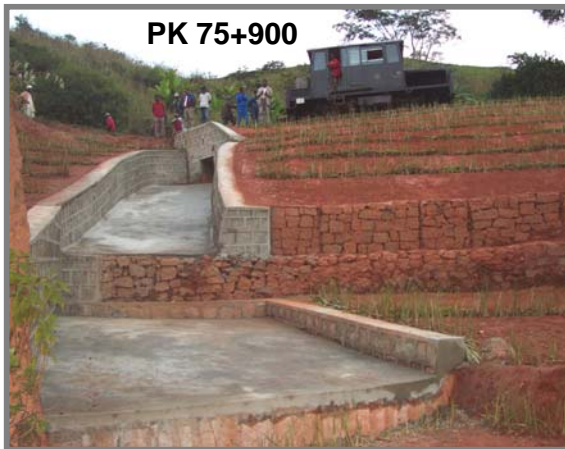
Rehabilitation and construction of drainage infrastructures

Task: The Master Plan identified 54 drainage infrastructures in need of rehabilitation and 10 new infrastructures that needed to be added because run-off has increased since the line was built. The lack of drainage structures and their lack of maintenance was a prime cause of cyclone damage to the line.

Achieved: The project rehabilitated 21 structures and constructed 10 new structures; all have been protected with vetiver to prevent erosion around the infrastructure.

PK where intervened: PK 42+996, 44+150, 44+215, 44+250, 44+600, 45+500, 45+700, 46+100, 46+350, 47+700, 50+820, 51+900, 53+070, 54+300, 66+350, 68+420, 71+450, 75+750, 75+790, 77+450, 80+400, 87+400, 102+500, 102+900, 109+00, 120+200, 121+000, 121+000b, 121+580, 123+330, 139+465.

Perspectives: 30 additional structures will be rehabilitated and 2 new structures built with European Union funds in 2003. Once these are funded, the line will be in good shape from a drainage point of view.



Note Concerning Track interventions in general

The approach taken on the track, which was badly in need of maintenance and repair over the whole length of the line, has been to address according to priority those issues which cause a risk to the transport of passengers or freight. Instead of fully rehabilitating one stretch before going on to the next (the classic method of track rehabilitation), we have made several "passes" over the line, each time addressing the issues of greatest urgency (whether ballast completion, replacing spikes and bolts, etc.) As a result, we have worked on most of the line at one time or another. The 40 km of "track rehabilitation" reported in the indicators are an indication of the impact had all the interventions been concentrated in the same area (as in a more classical rehabilitation effort).

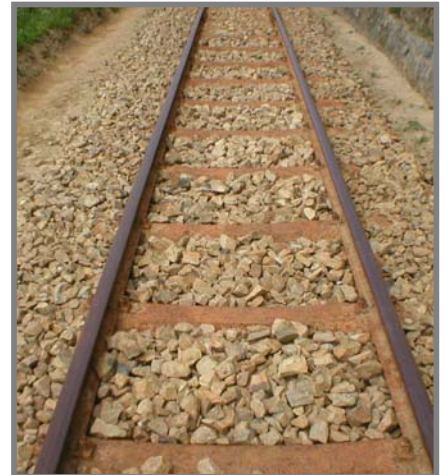
Cleaning of existing ballast and addition of complementary ballast.

Task: On much of the line, the track was reduced to little more than two rails running through packed earth. This is extremely dangerous and was a cause of numerous derailments. In such cases, the dirt must be cleaned out from under the tracks; the ballast removed and cleaned of dirt, and repacked with additional ballast as needed.

Achieved: 55 km of track have been cleaned and 1,740 cubic meters of ballast added to reach a minimum level of .2 cubic meters ballast per meter of track.

PK where intervened: PK 46+170 to PK 118+400 (cleaning), PK 46-54, PK65-76, PK 106-118 (addition)

Perspectives: There is still a need to add ballast to get up to the preferred dosage of .8m³ ballast per meter.



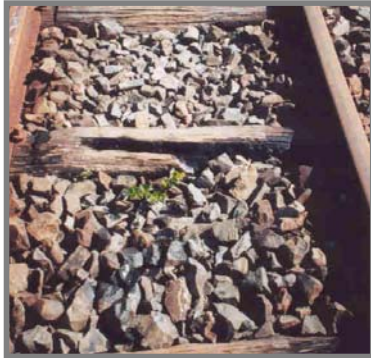
Replace rotten or damaged ties.

Task: The Master Plan calls for replacing 16,000 wooden and 6,400 metal ties that are rusted, rotted, or otherwise no longer structurally adequate. The damaged wooden ties are mostly in the dune section of the track; while the metal ties were often weakened from landslide damage that covered the tracks and accelerated rusting.

Achieved: The project replaced 6,600 ties with donated Swiss materials.

Principal zones of Intervention: PK 39-43, PK 65-71, PK 71-78, PK 81-82, PK 106-118, PK 118-123, PK 137-139, PK 149-161.

Perspectives: The remaining damaged ties will be replaced during the track rehabilitation scheduled for 2003-6 (financing by the EU, IPPTE, and the World Bank (APL2) .

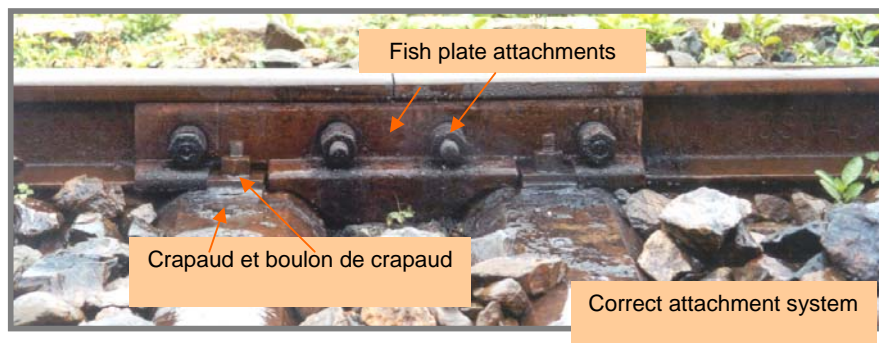


Ensure proper attachments of rails and ties.

Task: Inadequate maintenance, exacerbated by the difficulty of inspecting attachments when the track was buried under dirt, meant that many of the materials that bind the rails to one another and to the ties were missing or damaged. This is extremely dangerous in terms of track security and possible derailments.

Achieved: The project has purchased and replaced 129,500 track attachment parts (fishplates, nuts, bolts, and washers) and has also retrieved attachments from areas where the line has been welded and used them to strengthen other sections of track.

Perspectives: Once the line is totally welded, as anticipated for the World Bank track rehabilitation program, this issue will be resolved.



Cut damaged rail ends, weld rails, replace damaged sections.

Task : Because the tracks have not been refurbished for many years (or ever, in some parts), there is serious degradation of the rails and ties. However, analysis showed that many of the rails (even the original 19th Century rails) are still not at the wear limit and have a good 20 years life remaining. The ends of the rails are often the only part that is badly worn. The solution has been to cut the worn ends, weld (where resources permit) the rails and then replace the sections that have been removed with rails donated from Switzerland. Eventually this should be done on the entire length of track. In places (such as curves, tunnels, steep sections) where the wear rate is approaching or has exceeded the limit allowed, the entire rail must be replaced.

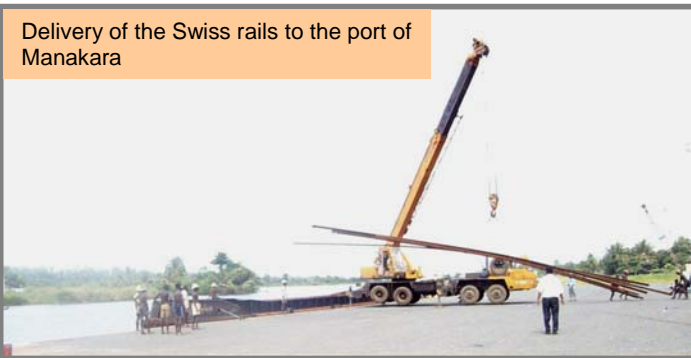
Achieved: The project has imported 5,630 m of donated Swiss rails, which have allowed the rehabilitation of ~ 10 km of track. 2,384 joints have been welded.

Technical note: By importing quality welding materials from South Africa (rather than France as has been the long tradition in Madagascar), the project has been able to reduce the price of welding materials by about 70% (from 540,000 fmg per kit to 150,000 fmg); we have also developed good relationships with the principal South African suppliers.

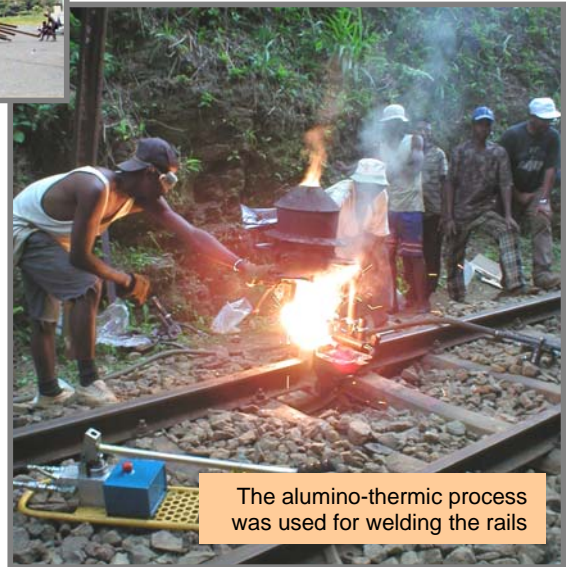
PK where intervened: PK 66-76, PK 118-121, PK 159-160.

Perspectives: An additional 8 km of track are expected to be rehabilitated with EU and IPPTE funds in 2003. The remaining track improvements (as needed from complete rehabilitation of the line) are scheduled for 2004-7 with World Bank funding (APL 2)...or as soon as the concession agreement is signed for the privatization of the line.

Delivery of the Swiss rails to the port of Manakara



Broken rail end to be cut and welded



The alumino-thermic process was used for welding the rails

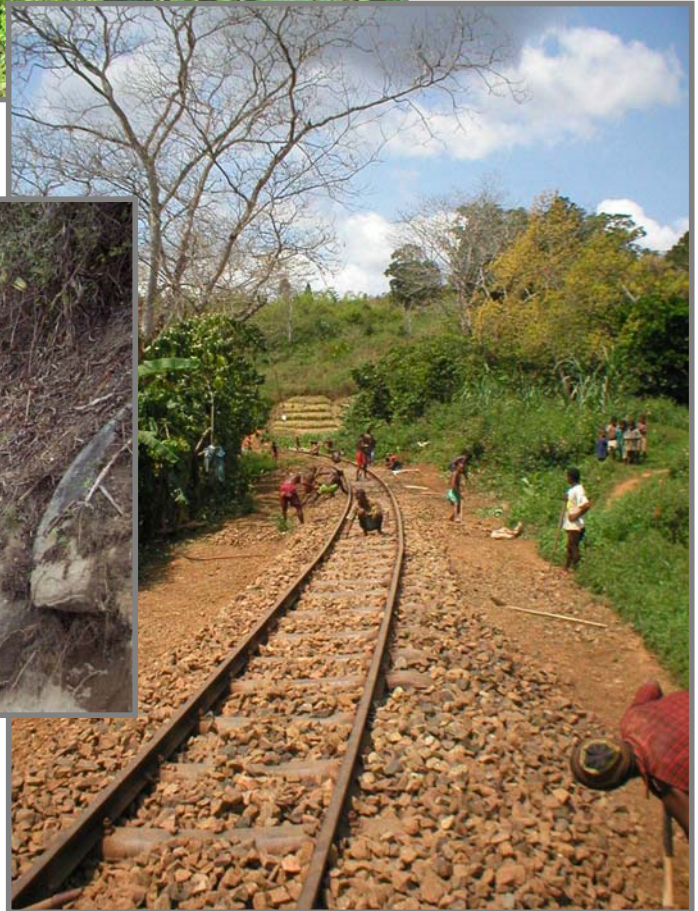


Track Cleaning.

Task: The entire line was badly overgrown when the cyclones hit, which contributed to damage by restricting the proper drainage of water from the line. Grass covering the tracks also caused the locomotives to skid on steep sections, putting serious wear and tear on the traction motors and contributing to their early failure. The line needed to be cleaned and regularly maintained.

Achieved: The project cleared all 163 km of the line (79 km with UNDP/Fianar funding) and tested new cost-effective systems for regular upkeep and maintenance.

Perspectives : The project will continue to work with the FCE to implement a regular cleaning schedule and to ensure that the platform is transferred to the concessionaire in excellent shape and that failure to maintain the line does not jeopardize the investments in drainage that have been made by the project.



Rolling Stock (~ \$1,380,000)

General note on rolling stock investments

The rolling stock at the FCE was in such bad shape that passenger and freight service was compromised, and it was also impossible to ensure the timely delivery of people and materials to work sites. The project focused on assuring the minimum repairs to rolling stock needed to ensure basic transport services for both the public and for our own rehabilitation efforts; this meant getting three locomotives and two *draisines* (motor trolleys used to transport workers) back into reliable service and repairing equipment such as specialized ballast and tunnel inspection wagons that were needed for repair of the FCE infrastructure. The project did not invest funds into passenger or general freight wagons, and these remain a weak link in the whole system. We expect to address this issue with IPPTE funds in 2003.

Rehabilitation and maintenance of three locomotives.

Task : When the project started, there were only two locomotives operating, and both of those had insufficient traction engines (3 per locomotive instead of 4), which significantly reduced their traction capacity and reliability (if one motor failed, the locomotive was immobilized). The Master Plan indicated that three reliable engines were needed to ensure both reliable service and timely delivery of work materials to rehabilitation sites.

Achieved. Thanks to a rehabilitation and maintenance contract signed with the Compagnie Internationale de Maintenance, as of March 2003 all three Alsthom BB locomotives had been fully rehabilitated and are now operating at > 80% reliability (therefore meeting or exceeding railway norms). We worked with the FCE to put in an effective system for managing and tracking parts used in the rehabilitation of the locomotives, and to facilitate timely parts orders in the future.

Perspectives: We are working with IPPTE funds and the FCE to ensure that parts are ordered and proper maintenance is carried out in the period leading up to privatization.



Locomotive parts at the Fianar workshop

Rehabilitation of work wagons: draisines (motor trolleys), ballast cars, tunnel inspection vehicle, etc..

Task : Rolling stock needed to transport people and materials to the work sites was in very poor repair and in some cases not usable. Timely delivery of materials required the rehabilitation of, especially, the two draisines, ballast carrying wagons, as well as the tunnel inspection/repair wagon.

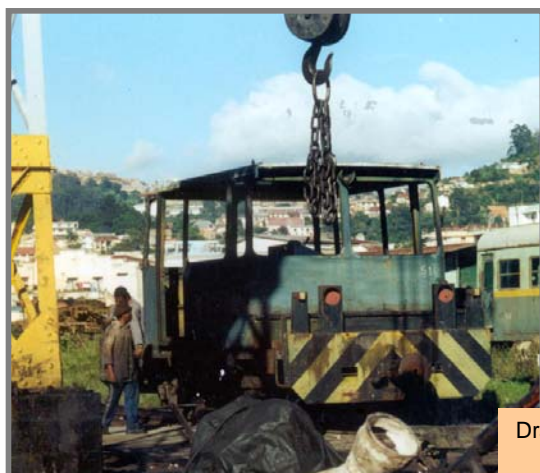
Achieved: Both draisines were rehabilitated and kept maintained (operational at > 80%) on contract with a local firm. In addition, 7 ballast cars, 1 tunnel repair vehicle, 7 other wagons for carrying work supplies (cement, sand, etc.) were rehabilitated under the project's Fast Track interventions. Work was carried out by private contractors, thereby suggesting a cost-effective and efficient alternative to the usual way of working through the overextended and under-motivated FCE teams.



Ballast wagons



Tunnel inspection vehicle



Draisines



The Community Helps to Save a Railroad : Participatory Erosion Control (~\$58,000)

Train farmers in slope stabilization techniques using perennial agriculture models.

Task: Traditional cultivation techniques along the line (in which manioc is uprooted shortly before the rainy season) contributed to erosion and landslips. We sought to provide an alternative farming model that would assure the farmers' livelihoods, while (at a minimum) not jeopardizing the train line and (ideally) contributing to further slope stabilization.

Achieved: 627 (of which 353 financed under FCER) farmers along the line have now adopted alternative cultivation techniques based around proven slope stabilization technologies using vetiver and tree crops; 1,386,182 vetiver slips have been planted on farmers' fields adjacent to the line under FCER funding. In addition, 98,680 slips of vetiver have been planted to stabilize drainage and infrastructures and the community volet has developed a program whereby villagers have responsibility for maintaining this vetiver. It should be noted that in total (LDI, FCER, World Bank funding), 2,635, 463 slips of vetiver have now been planted along the train line.

Zone of intervention (Community intervention): PK 30 to PK 130

Perspectives: The World Bank is funding this intervention in 2003 under APL 1 funds and plans to continue funding future seasons (2004-7) under APL 2. In addition, the intervention is self-sustainable in so far as all the knowledge and materials needed to expand the impact (eventually even away from the train line) are now functional and available in the communities along the line.

Modalities of the Intervention...

Eligibility: Farmers with fields abutting the railroad are eligible to participate; priority is given to fields on particularly vulnerable (steep or unstable) slopes and those that have been recently planted in manioc and/or rice

Conditions:

- The farm family provides all labor needed for the intervention.
- The project loans the family the vetiver needed to stabilize the field and they agree to repay the same quantity of vetiver the following year.
- The project provides tree and perennial crops according to the "module" system
- If the farmer needs to borrow seeds for annual crops (maize, beans), this too will be paid back in the following year.

Technical Assistance: The project had one designated "village agent" in each of the main train station villages along the line. These were farmers from the village, respected by their neighbors, who were trained in the slope stabilization methods and also learned to grow the tree stock used in the project and graft the stock with improved varieties.

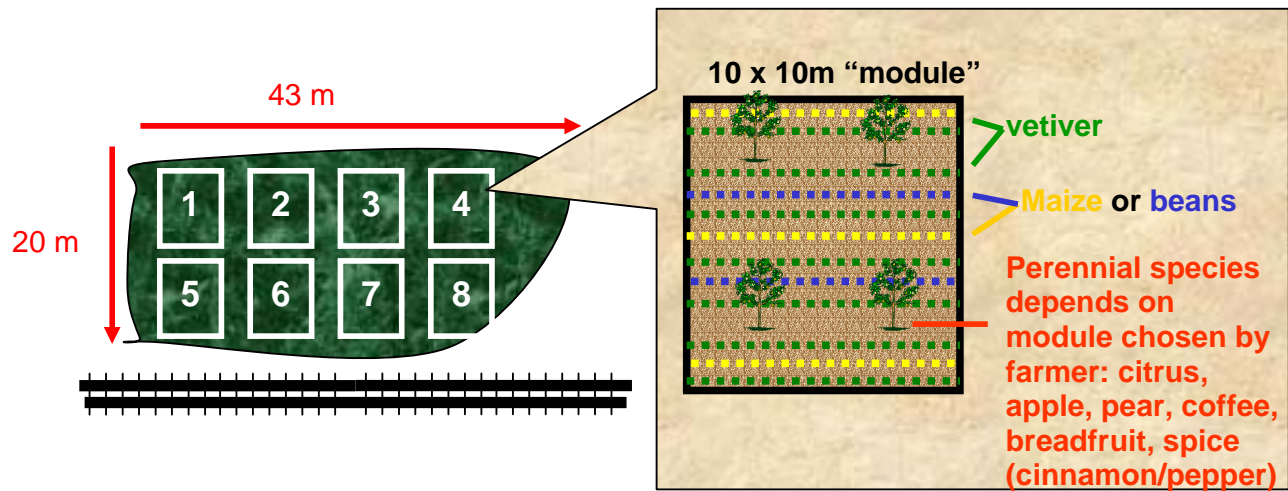
Step 1: Fields to be stabilized are identified with farmers (priority given to those that are most erosion prone and where rice or manioc was planted the previous year)



Step 2: Farmer obtains 10-year use rights to field from FCE train line (all land belongs to the 50 m railway right-of-way), with clearly defined rights and responsibilities of the farmer and the FCE.



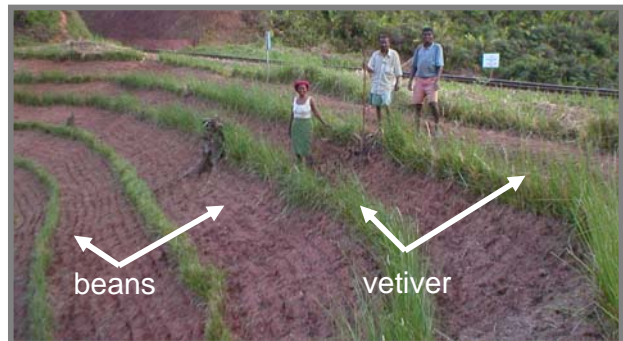
Step 3: With the village agent, farmer measures field, determines how many modules s/he can use, and selects modules according to personal choice (subject to certain technical constraints)



Step 4: Farmer clears field and plants vetiver (received as a loan from the project) on contour lines at 1-meter vertical intervals



Step 5: Farmer inter-plants annual crops and perennial tree crops between the vetiver rows



Follow-up: Farmer reimburses (and replants) vetiver in second season, keeps vetiver well pruned, correctly maintains tree and spice crops



Well trimmed vetiver hedgerow



Mr. Diti, Thai vetiver specialist, sports a hat and vest made from "FCE vetiver"



Farmers will begin commercializing pepper from FCE fields this year; fruit trees will produce from next year. Participating farmers have formed an association to facilitate commercialization of their crops

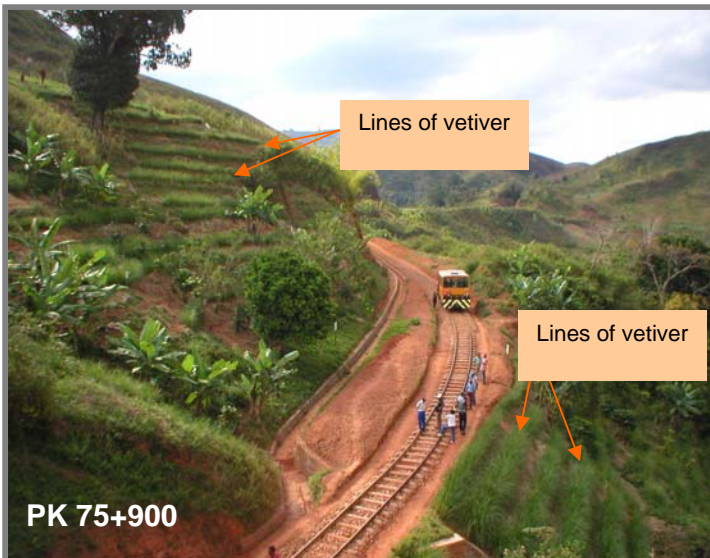
Result: steep slopes stabilized by vetiver from PK 30 to PK 130.

627 farmers now participate along the train right-of-way, improving their own livelihoods at the same time as they help to protect the railway from erosion and landslides.

Once established, each of these fields of vetiver acts as a nursery and farmers along the line contribute their vetiver to other farmers (during the reimbursement and after) and have also sold vetiver to road and other infrastructure projects.

In addition, farmers gain the benefits of the vetiver, which:

- increases soil fertility (the vetiver prevents erosion and makes a nutrient rich mulch),
- can be used as animal fodder when young,
- can be used to make handicrafts (that draw a premium price compared to products made with other local grasses because of their durability and suppleness) or to thatch houses.



Lovantsika ny lalamby : ka arovy

This train line is our heritage :

Let's protect it

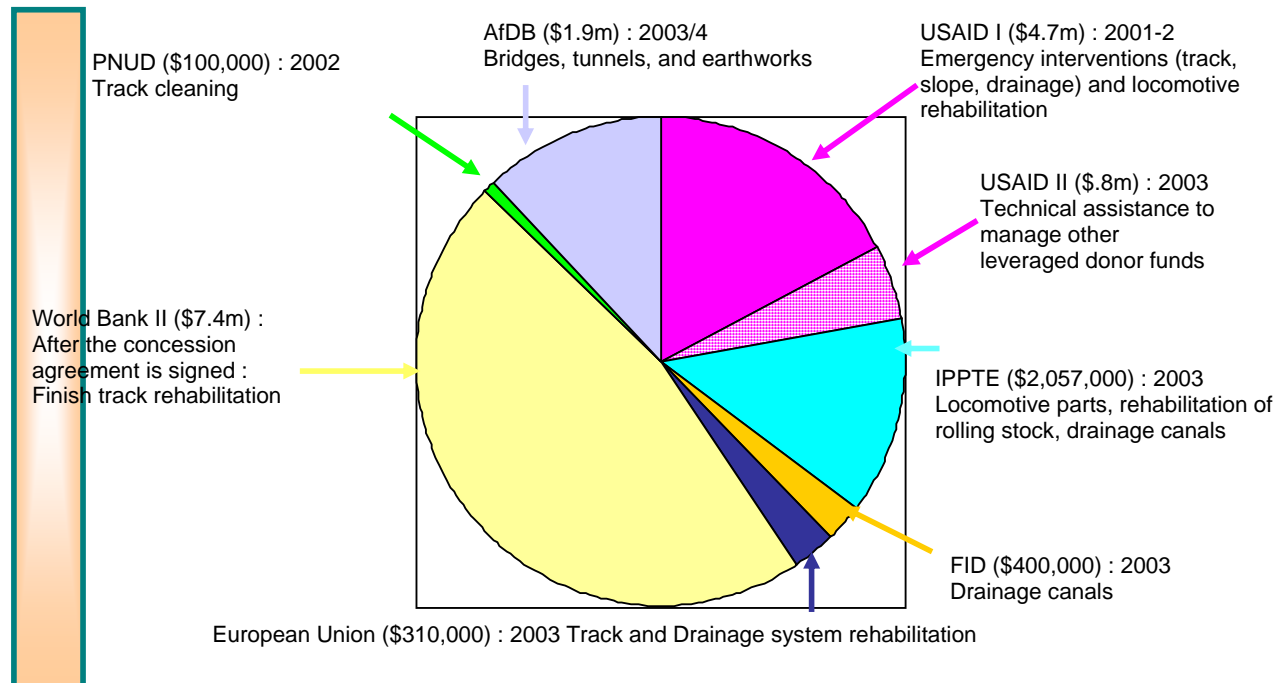
The farmer whose field is shown at left



II. 3. Additional Project Results

In addition to the interventions outlined in the previous section, the project is pleased to report on the following accomplishments

II.3.a Fund Leveraging. While the FCER had always hoped to leverage additional funds for the rail rehabilitation project (and had proposed from the outset such activities as the Donor Roundtable with this goal in mind), it is always hard to predict with any certainty the likely success of achieving objectives that are beyond the strict control of the project team and, in addition, subject to the vagaries of other donors' policies and politics. While we have been buffeted by apparent commitments that were later renounced, and timelines that have been postponed time after time, at this point we remain guardedly optimistic that we have succeeded in our objective of putting together a consortium of donors that will fund the full rehabilitation of the FCE line as per the Master Plan design.



Specifically:

World Bank. Thanks to strong economic arguments (resulting largely from research carried out under the IRG-PAGE project) and persistent lobbying, the World Bank has changed their position regarding the FCE and no longer argues that it must be closed because it is not financially profitable. Rather, they are convinced by the cost-benefit analyses showing the public good that will result (in terms of the contribution the FCE makes to conserving the forest corridor, whose benefits can be quantified in economic terms) from keeping the FCE alive and that justify the investment of public funds. The World Bank has committed \$7.2 million to the FCE rehabilitation effort, with the only condition being that it is privatized or otherwise subject to private management/operation before they will release any funds. They have already demonstrated their commitment to the FCE by funding the necessary studies to prepare the privatization dossier as well as the 2003 Community Interventions.

Japanese Embassy. We had high hopes of receiving Japanese government *Fonds Contre-Valeurs* for installing track and drainage systems, but those hopes were dashed when the decision was taken in Tokyo not to finance improvements to a rail system that was due for privatization. We believe that we have been able to largely compensate for this loss by obtaining commitments from the European Union and Debt Relief Funds (IPPTE) that have been accorded by the Government of Madagascar.

African Development Bank. The African Development Bank gave their agreement (in principle) to fund cyclone rehabilitation activities at about the same time that FCER was funded by USAID and, indeed, the contract with Chemonics called for the project to prepare the tender offer for the works to be carried out by the AfDB. While the AfDB has never wavered from their stated intention to fund bridge, tunnel, and earthworks rehabilitation, their funding has been considerably delayed, and all projects in Madagascar were put on hold during the political crisis of 2002. In the meantime, the FCER project drafted the necessary tender documents and has since worked with the AfDB to finalize these tenders. We are at this point optimistic that the tenders will be issued and work can begin in the second semester of 2003.

One positive point is that, while at one point the AfDB had indicated that it was unlikely to maintain its initial commitment of funds (~ \$2 million) and would instead allocate only 2/3 of the initially anticipated amount as a « firm » credit (with the rest being conditional on finding additional funds), a representative of the AfDB visited the line in April 2003 and has now reconfirmed their intention to fully fund the \$1.9 million of work initially budgeted.

UNDP. The UNDP has been a difficult partner; fortunately we never counted on significant funding from this source and never budgeted UN funds to the most critical activities. As a result, we have been able to weather the vagaries of their commitment. The Fianarantsoa regional office contributed \$100,000 to track cleaning, which was helpful because it was made available with little paperwork and early in the process. In contrast, the money that was « promised » through the UNDP environmental program (an initial \$25,000 with hopes for more) involved massive amounts of paperwork and, at the last minute, was rejected by staff in New York who were unable to detect the linkage between transport and environment.

Swiss Solidarity Network. Thanks to Frank West's persistent and persuasive efforts, the Swiss Solidarity Network continues to be an important partner to the FCE. Over the course of the project, we brought in some \$375,000 of used Swiss railroad materials and expanded the network to the point where 14 Swiss railways are now participating and have contributed materials to advance the rehabilitation and privatization efforts. Frank also helped obtain critical parts and materials at or below cost (such as the traction motors obtained from a French mining company), thereby

FCER has successfully leveraged more than twice the resources invested by USAID from other donors and put the FCE railway back on the “national transport map.”

Using persuasive and well substantiated analytic arguments to justify the rehabilitation of the FCE with public and donor funds, and by demonstrating a record of cost effective and timely interventions, the FCER project has been able to persuade formerly reluctant donors (notably the World Bank and European Union) to join the rehabilitation effort. As the FCER project draws to a close, we have commitments in hand as needed to fund approximately 95% of the Master Plan for the FCE's rehabilitation.

As important as the funds raised is the fact that the previously forgotten FCE railway now figures prominently in Madagascar's national transport plan. The GoM is committed to maintaining the national rail network and reviving transport policies that encourage the transport of heavy and bulky materials by rail, rather than road.

saving the project several hundred thousand dollars that could be put to other pressing needs. The project has scrupulously complied with all regulations concerning acquisition/transport of used materials with USAID funds.

European Union. The European Union, which had previously expressed little interest in funding Madagascar's railroad system, has now joined the consortium of donors. In 2003 they have committed 365,000 Euros to the track and drainage works. Specific member countries (namely Britain) have also contributed funds that, while modest in their amount, have provided significant help at key moments (especially in financing Swiss rail shipments) and helped to stimulate greater support from the EU.

Coordinating various donor funds and respecting the procedures of each funder has been one of the most challenging (and at times frustrating) aspects of this project. We believe, however, that the impact of leveraging \$4.7 million of USAID funds into a package that is now likely to exceed \$14 million has fully justified the time spent in managing these diverse funding sources. The end result is that, whereas when CAP and LDI started funding railroad activities there was considerable skepticism from other donors that this was a well considered investment, in the recent (May 2003) National Transport Sector Conference there was universal and unanimous support for keeping the FCE railway in operation from both donors and government.

II.3.b Strengthening Malagasy Firms. One of the successes of this project has been the development of private enterprises willing and able to carry out railroad rehabilitation and maintenance work. Experience shows that contracting out such activities to private companies with clear standards of quality control and expected deliverables has generally been more effective than working through the parastatal railway company. The FCE and the RNCFM were initially reluctant to use the contracting approach, justifying their continued intervention on the fact that the work to be done required particular railroad competence. In fact, we have found that much of the work to be done (ditch clearing, slope stabilization, drainage) can be done by firms that have experience with roads and other civil engineering activities. Some work (such as track weeding and vetiver planting) can even be done by village associations. When there are specific technical issues related to the rail system, it still works best to hire a competent private firm that then hires railroad expertise as needed, rather than working « *en régie* » with the railroad workers.

As a result of working through local enterprises, there are now several small and medium sized firms in Fianarantsoa (several of which are owned by women) that have built up the capacity to implement railroad rehabilitation contracts (including ballast and tie production, and track laying, cleaning, and maintenance) as well as slope stabilization with vetiver. By using these firms, rather than international or large (Antananarivo based) national companies, the project has been able to do the work much less expensively and has significantly contributed to local capacity building for these smaller companies.

Small firms have proved to be cost-effective subcontractors.

In early tenders, we consulted both international and local firms for a track work contract. The price proposed by the international firm was 2.3 times as high as that proposed by the local company. In some cases, the local firms have required a certain amount of mentoring (and always careful monitoring), but the results have always been satisfactory in the end.

In addition, we have encouraged a group of former railroad workers (initially hired by FCER to do quality control on our contracts) to spin off railroad enterprises (Association LAMA and Enterprise EE_TGCFM) that will be able to contract to do future work on both the southern and northern railway lines. This follows a model similar to the one used when CAP project employees created the very successful NGO Lalana to work on roads.

II.3.c Model Vetiver Intervention. Building on work initially carried out with LDI and the CAP project before it, the FCER project has developed an innovative approach to slope

Mobilizing Local Populations in the Rehabilitation Effort.

From the outset the FCER project has had a policy of mobilizing local populations in the rehabilitation effort. The most obvious manifestation of this approach is the community vetiver scheme which, rather than depriving farmers of the lands they have farmed along the rail right-of-way, enlisted their help in an activity that both stabilizes slopes subject to erosion, and provides better income for the farmer.

The community intervention also has an Ombudsman on staff whose job it is to ensure that the population is well informed of project activities and the project understands and responds to community concerns. The ombudsman has responded to issues as diverse as delays in payment of salaries to day-workers hired by companies contracted by the project and local suggestions that carrying out certain cultural rites could help to reduce derailments at a certain spot on the line.

stabilization and environmental restoration along the railroad line. While the principal purpose of this intervention has been to reduce erosion that causes landslides and slips along the rail line, it has numerous potential applications for environmental restoration in the wider context. Several aspects of this intervention are particularly notable in terms of the wider dissemination of this approach, which has been proposed for the King of Thailand's annual vetiver award in recognition of its creativity, efficacy, and impact.

1. **The « Modular Design » Factor.** The system used along the FCE is based on a modular design that allows the farmer to customize his/her field based on personal economic choices and conditions. Each module is a 10m x 10m square that involves vetiver planted along the contours and intercropped with trees and annual crops. The project proposed six choices of modules (initially five, but now expanded), depending on the perennial crop that provides the

economic « back-bone » for the module: apple or pear trees, coffee, citrus, breadfruit, and spices (cinnamon and pepper). The farmer first measures his/her field to determine how many total modules can be used, then selects according to technical appropriateness and his/her own preferences. Farmers are encouraged to diversify the modules they select in order to diminish risk; a given farmer might choose 3 spice, 2 apple, 2 citrus, and 2 breadfruit modules to stabilize a 30 x 30 meter field bordering the rail line, for example. The system allows for quick and effective dissemination without requiring the uniformity and standardization that often characterize rapid approaches.

2. **Vetiver-for-vetiver loan/repayment scheme.** To contain costs and encourage wider dissemination, the project has developed a system in which the farmer receives his/her first allocation of vetiver (enough to fully stabilize the field) as a loan. After a year, s/he repays the vetiver by digging up a clump (initially planted as a single slip but now multiplied into a clump of perhaps 20 or 25 slips), replanting one slip, and reimbursing the remaining plants to the project. These plants are then provided to another farmer, who will reimburse in turn the following year. This system has not only significantly reduced the cost of vetiver acquisition for the project but has shown farmers that they can easily share vetiver among themselves at almost no cost, thereby making the approach easily replicable. While the project has only intervened on fields directly abutting (within 50 meters of) the track, some farmers have already taken the initiative to « vetiverize » fields more distant from the railway. The waiting list (after the first year) of farmers desiring to participate in the Community Intervention demonstrates conclusively that farmers in this region are

interested in the erosion control and soil fertility aspects of vetiver and suggests that wider dissemination should be possible in Madagascar.

3. **Use of vetiver for technical interventions.** The systematic use of vetiver to stabilize slopes and protect infrastructures along the line has added significantly to knowledge of biological engineering « best practices » in Madagascar. Most previous uses of vetiver to protect infrastructures (in Madagascar) were limited to fairly modest interventions of slopes immediately adjoining roads. Emboldened by the Thai experience (after two Thai specialists came to Madagascar to work with LDI on vetiver issues shortly after the cyclones), FCER experimented along much steeper and higher slopes with notable success. The project is now in the process of more fully documenting this experience.

Among the key lessons learned in this regard are the following:

- Steep up-slopes (above the track) that have been subject to erosion and landslides are the most challenging in terms of vetiver stabilization because of the difficulties of correctly compacting the slope and the absence of topsoil. FCER experience suggests that vetiver can be used very effectively in most such cases, but it is worth investing in the more expensive potted vetiver plants (already well rooted in plastic bags) than the cheaper bare-rooted slips. Bare rooted slips, on the other hand, work perfectly well and are more cost effective when used to protect infrastructures, most down-slopes, and gentle or undisturbed up-slopes.
- Provision should be made for the continued up-keep of vetiver wherever it is planted since vetiver that is pruned regularly is more effective (because it develops a deeper root structure more quickly) than plants that are left to develop naturally. The project developed an effective system in which farmers living near the vetiverized « points noirs » are contracted to prune and weed the plots in exchange for the use (for mulch, handicrafts, thatch, animal fodder) of the vetiver clippings.

The FCER's vetiver intervention has the potential for wider adoption.

Already the new private operator of the northern railway line (Madarail) has begun using the techniques developed by FCER to stabilize similarly vulnerable points along the Tana-Tamatave line and to work with communities to vetiverize steep slopes that are being farmed in the rail right-of-way.

II.3.d Strengthening Solidarity Around the FCE Train Line. A hallmark of the FCER project, relative to other more classical infrastructure projects, has been its systematic attention to including the local population in all aspects of the rehabilitation effort and engaging their support throughout the project. We have been fortunate in this regard to work with the PACT/MIRAY and LDI teams (and to build on the previous actions of both the CAP and LDI projects) who have reinforced our efforts to develop community based institutions the length of the rail line. While such participatory approaches may at times seem superfluous or « luxurious » when dealing with disasters such as the Madagascar cyclones, they have proven time and again to be worthwhile investments. The project ombudsman has provided invaluable assistance in resolving problems with the rehabilitation efforts (e.g. contractors not respecting payment schedules of local workers, land tenure disputes) but even more often has played an uncounted role in assuring that negative issues are dealt with before they become real problems that divert the time and resources of other staff people.

The most dramatic evidence of the importance of this participatory approach was the notable fact that while all the other transport infrastructures between the highland and the coast were dynamited, destroyed, or barricaded during the political crisis of 2002, the FCE (though on the list of structures to be targeted) was not in fact damaged. This was because the local population banded together regardless of political affiliation in support of the FCE and key provincial authorities (members of the OPCI, or inter-communal association to save the railway) refused orders to destroy the rail infrastructure.



As economic terrorists bombed the infrastructures around Fianarantsoa during the political crisis of 2002 (this photo shows the RN 7 north of Fianarantsoa), local populations along the FCE mobilized to protect the rail line and ensure that bridges on the FCE did **not** suffer a similar fate.

It is significant that at the start of the railroad rehabilitation activities, there was palpable distrust and antagonism between the local population and the railway workers. Indeed, an initial meeting hosted by LDI to discuss the future of the line shortly after the cyclones hit came almost to blows due to the

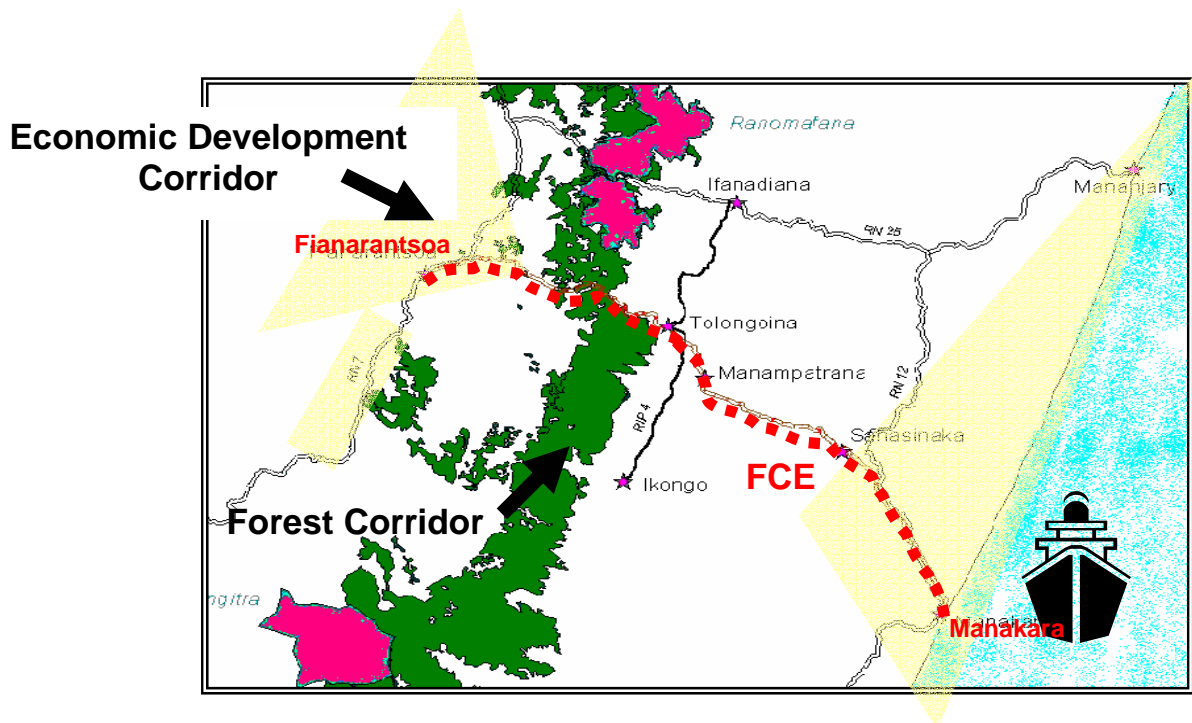
antagonism between these two groups, each of whom blamed the other for the then piteous state of the rail system. By focusing on common visions and concerns and providing a forum in which honest and constructive discussions can take place, LDI, MIRAY, and FCER have worked together with very positive results to increase communication and build trust between these groups. This new institutional arrangement has been codified in the SITE, which is a tripartite agreement between the FCE, the OPCI (Inter-communal committee of the 19 communes along the train line), and ADI-FCE (Rail Users Association) to work together in pursuit of common objectives to improve rail service and the sustainable operation of the line.

II.3.e Advancing a Coherent Vision of Provincial Economic Development.

While much of the project's efforts have been devoted to the mechanics of rebuilding the badly damaged FCE train system, we have tried not to lose sight of the fact that the infrastructure is not the end goal, but rather a means to providing improved transport services so as to promote economic development in the province and thereby reduce poverty and pressures on the forest corridor. As such, we have been instrumental (in conjunction with LDI) in promoting an integrated vision of development in the province of Fianarantsoa that combines transportation/environment/economic development. Specifically, we have contributed to developing the concept of an « *economic development corridor* » (based on the rehabilitation of the transport corridor between Fianarantsoa and the coast) that will in turn serve to conserve the « *forest corridor* » that is so vital to sustainable development and the hydrological integrity of the province. These themes have become familiar in government and development circles in the Fianarantsoa province and have helped to provide a vision for both provincial development and the effective interventions by other donors (as well as the next round of USAID funded initiatives).

As a result of this shared vision, there is now a network of donor interventions the length of the train line, and in an area that was largely forgotten even before the cyclones hit because erratic train service was such a handicap to both social and economic development. Current and potential interventions as a result of more reliable rail service include :

- ❑ Major interventions by FID and PSDR (World Bank funded) to support development planning by communes along the train line
- ❑ TIAVO credit programs at major stations along the line
- ❑ The placement of Peace Corps volunteers in key villages along the line
- ❑ Packard funded water and health interventions in communes adjacent to the tracks
- ❑ Increasing STABEX (EU) funded interventions to support commercial agriculture
- ❑ Private enterprise exploring the possibility of investing in fruit processing activities in Manakara
- ❑ World Bank interest in funding MIT (*Moyens Intermediaires de Transport*) technologies to link remote villages to the railhead.
- ❑ And renewed interest in developing the Port of Manakara and/or the Pangalane canal in order to restore the integrated communications/transport system so vital to the Province of Fianarantsoa.



III. Follow up to the FCER project

Funding for USAID cyclone activities under the FCER project ended on April 30, 2003. Given the availability of other funds to continue the rehabilitation effort (specifically, from the European Union and IPPTE), the FCER project requested USAID to fund the core project staff under the LDI extension to ensure that additional funds would be well spent and that there would be a seamless transition through the privatization of the railway line (now programmed for late 2003). This extension was in part justified by the fact that the 2002 political crisis made it impossible to carry out the privatization during 2002, as initially anticipated, and that any significant gap between the end of project activities and the effective take-over by a private operator would in all likelihood lead to a deterioration of the physical and financial situation at the FCE.

Thus, the core technical and support staff for the project has been extended through the end of LDI (November 2003) and are currently working to implement more than \$2.3 million worth of rehabilitation activities (funded primarily by the EU and IPPTE funds, with support from the Swiss Solidarity network) before the end of the year. Working with LDI, we continue to be very involved in promoting the rapid privatization of the railway and ensuring the proper maintenance of infrastructures and rolling stock until the concession process is completed.

The FCER project has worked closely with both the AfDB and the World Bank to ensure that major interventions funded by these two donors are coherent with the Master Plan developed by the project and valorize both technical (e.g. use of vetiver in slope stabilization) and institutional (e.g. community support and the Swiss solidarity network) innovations already in place as a result of FCER and previous USAID funded projects.

The project helped to assure the continued funding of the Community Intervention (4th Season) under World Bank APL 1 and will continue over the next year to facilitate and

Synergies between USAID funded projects have significantly increased the impact of our development interventions in the Fianarantsoa province.

LDI, RECAP, and FCER have worked in close collaboration to restore the integrated transport system (port/rail/feeder roads) that are vital to commercial agriculture and conservation of the forest corridor. LDI and MIRAY have also worked collaboratively with FCER in nurturing the civil society (ADI-FCE, AUPs) and local governance (OPCI) structures that are so critical to ensuring the sustainability of these infrastructure investments.

provide guidance as needed to the Haona Soa team implementing this program (we continue to occupy the same office space until the end of the LDI program).

Project staff members have worked closely with USAID staff and consultants to explore ways in which the investments made in reopening and rehabilitating the railroad can be valorized in future projects funded by USAID in the Fianarantsoa region. It is our fervent hope that, just as synergies between complementary projects in the Fianarantsoa region (MIRAY, LDI,

FCER, RECAP) over the past five years have allowed us to achieve more than the sum of our parts, so will synergies over time between successive projects (CAP-LDI/FCER-future USAID funded activities) ensure that USAID projects in Fianarantsoa are welcomed and respected for their efficiency, efficacy, and sustained trust and good relations with regional partners. The FCER project is proud of whatever modest contribution it has made to achieving these highly commendable results.

IV. Funds Expenditures

Level of Effort Table

Name & Category	Total Budgeted LOE	Total LOE
Chief of Party - Jean-Robert Estimé	52	51
Regional Director – Karen Freudenberger	382	531
Controller/Contracts Manager - Hayley Bryant	0	451
Planning Director - H Shar	166	131
External Liaison - Frank West	170	142
Advisory Engineer - Louis Venault	168	60
Advisory Engineer - Philippe Martin	144	30
Controller/Contracts Manager - Jean-Luc Aldorf	242	50
Inspector - Kurt Schrotberger	0	12
Senior Manager - Sally Cameron	36	6
Project Administrator - Karen Jung	36	76
Contracts - Jennifer Brinkerhoff-Zengue / Gita Maitra	4	20
Accountant - Ousmane. N'Diaye	17	9
Other	14	14
Total LOE (Days)	1,452	1,582

Funds Expenditures

Total Budget	\$4,850,000
Total Expended through May 30, 2003	\$4,848,256

	Budget	Expended
Work Days Ordered*	\$1,357,847	\$1,361,311
Materials	\$3,336,797	\$3,337,879
G&A	\$155,357	\$149,066
Total	\$4,850,001	\$4,848,256

*We have submitted a modification request to move \$3,464.00 from Materials to Work Days Ordered. The figures above reflect an approval of this request by USAID.

Annex 1

Initial Key Indicators as Defined by the Task Order and Revised Indicators

1. Initial Indicators

- ❑ 1000 meters of tunnel repaired
- ❑ 126 meters of bridge repaired
- ❑ 25,000 meters of structures repaired
- ❑ 6,000 meters of breast wall constructed
- ❑ 800 hectares of abutting embankments stabilized
- ❑ 3,000 meters of alignment stabilized

2. Revised Indicators

- ❑ 25 km of drainage ditches cleaned and maintained
- ❑ 21 drains or culverts rehabilitated
- ❑ 10 new drains or culverts completed
- ❑ 125,000 linear meters of vetiver planted to stabilize embankments and reinforce drainage structures
- ❑ 300 farmers trained in hill-slope stabilization techniques
- ❑ 40 km of track stabilized
- ❑ Return to Service of 1.5 km of track between rail station and port of Manakara
- ❑ 3 locomotives functioning at 80%

Annex 2

Key Documents Assembled Over Course of Project

Technical Studies

Projet de Réhabilitation de la Ligne Fianarantsoa-Côte Est « FCE » : Avant Projet Détaillé Report (Study by Dinika International, June 2001)

Projet de Réhabilitation de la Ligne Fianarantsoa-Côte Est « FCE » : Avant Projet Détaillé Annexes (Study by Dinika International, June 2001)

Projet de Réhabilitation de la Ligne FCE : Master Plan Actualisé (Study by Association LAMA, January 2003)

Socio-Economic Studies

Analyse des Impacts du Système Ferroviaire FCE sur L'Economie Régionale ; Vol 1 : Synthèse de l'Analyse Qualitative et l'Analyse Coût Bénéfice. (Programme PAGE/EPIQ, October 2000)

Analyse des Impacts du Système Ferroviaire FCE sur L'Economie Régionale ; Vol 2 : Résultats de l'Analyse Coût-Bénéfice. (Programme PAGE/EPIQ, October 2000)

Analyse des Impacts du Système Ferroviaire FCE sur L'Economie Régionale ; Vol 3 : Résultats des Recherches Qualitatives. (Programme PAGE/EPIQ, October 2000)

Environmental Impact

Etude d'Impact Environnemental : Travaux de Réhabilitation de la Ligne Fianarantsoa-Côte Est (FCE) (Report by Dinika International, August 2001)

Réhabilitation du Chemin de Fer FCE : Rapport Périodique sur Les Mesures Environnementales Entreprises dans les Activités Financées par le Projet FCER (Document soumis à l'ONE, 4 février 2003)

Volet Communautaire

Stratégie pour l'Aménagement des Talus Vulnérables (Report by LDI/Unité FCE, September 2000)

Synthèse de la Première Campagne d' Aménagement des Talus Vulnérables le long de la Ligne FCE (Report by Association Haona Soa, February 2001)

Rapport Synthétique et Analytique de la 3^{ème} Campagne de Réhabilitation des Talus avec les Riverains de la FCE (Report by Association Haona Sao, October 2002)

Diti Hengchaovanich and Karen Schoonmaker Freudenberger. "Vetiver Victorious: The Systematic Use of Vetiver to Save Madagascar's FCE Railway." (submitted for Publication by the Royal Projects Development Board, Thailand, May 2003)

Annex 3 Locomotive and Draisine Availability Table

	Locomotive			Draisine	
	242	245	243	YC 046	YC 051
Date put in Service	12 July 02	28 September 02	08 April 03	6 September 02	6 September 02
Month	Performance Availability (Minimum required = 80%)				
Aug 02	100%	x	x	x	x
Sept 02	100%	x	x	x	x
Oct 02	100%	99%	x	100%	100%
Nov 02	97%	99%	x	99%	99%
Dec 02	99%	98%	x	82%	98%
Jan 03	97%	97%	x	92%	93%
Feb 03	93%	96%	x	End maintenance contract	
March 03	93%	97%	x		
April 03	93%	93%	73%		
May 03	93%	93%	93%		

Annex 4
Value of Swiss Donations Received by Category

Material	Quantity	Estimated \$ Value	Notes
Rails	5,630m	\$53,710	Value calculated as if we'd had to buy this quantity of reconditioned 36 kg rail from South Africa
Ties	6,600	\$118,800	Value calculated as if we'd had to buy this number of ties from South Africa
Wagons	3	\$130,000	
Track materials, attachments, and diverse		\$82,216	Includes grinding disks, electric generator, work clothes, rail attachments (fishplates, bolts, etc), tamping machines, welding equipment, and other track laying equipment
TOTAL		384,726	

Annex 5 Vetiver Statistics

Vetiver Planted to Stabilize the FCE Railway (Interventions Financed by LDI, FCER, World Bank)

I. Vetiver planted to Stabilize “Points Noirs”

Company	Number vetiver slips planted	PK
Mac Donald	65,000	PK 46+000; PK 74+050; PK 76+350; PK 80+400; PK 98+050; PK 103+800; PK 112+350; PK 121+000 (Manakara side)
Edminess	25,000	PK 44+075; PK 50+800; PK 68+800; PK 75+750; PK 80+400; PK 102+900
Ratsimbazafy	25,000	PK 121+000 (Fianarantsoa side)
Ratsimbazafy	21,000	PK 58+100; PK 89+300; PK 90+200; PK 102+500; PK 119+350; PK 121+950
RJO, KOJA, BTPS	27,680	PK 31+100; PK 80+400; PK 105+100; PK 105+800; PK 106+000
TOTAL	163,680	

Total LDI : 65,000

Total FCER : 98,680

II. Vetiver planted by farmers in FCE Right-of-Way

Statistic	1 st Season (financed LDI)	2 nd Season (financed under FCER)	3 rd Season (financed under FCER)	4 th Season (Financed World Bank)	Total
Number of participants	95	158	195	179	627
Surface area planted (m ²)	42,686	93,700	104,326	89,017	329,729
No. Vetiver slips planted	298,802	655,900	730,282	623,119	2,308,103
Linear meters vetiver planted	29,880	65,590	73,028	62,311	230,810
Source of vetiver	100% from external nurseries	30% from farmer reimbursements, 55% from outside nurseries, 15% purchased from 1 st season farmers	80% from farmer reimbursement; 20% purchased from 1 st and 2 nd season farmers	100% from farmer reimbursement	

Total Community Vetiver planted : 2,308,103 of which 1,386,182 slips financed under FCER

Total vetiver planted along the FCE Railway line (all funders, community and *points noirs*): 2,635,463 slips